

REMARKS/ARGUMENTS

This Amendment responds to issues raised in the Official Action of February 17, 2006, a Final Rejection, and accompanies a Request for Continued Examination (RCE).

Claims 11-16 are pending in the application.

Responsive to item 3 of the Official Action of February 17, 2006, the dependency of claim 15 has been adjusted to depend from claim 11, as the examiner suggests.

The balance of the Official Action is two prior art-based rejections, items 4 and 5, of claims 11-16.

As a preliminary matter, it is submitted that the claims of this application, in particular method claims 11-14, are not being properly examined. These claims require a series of operative steps and manipulations and attention must be paid to the materials used and conditions employed in the various steps in particular in the order in which they are conducted.

In item 6 of the most recent Official Action the examiner dismisses applicants' earlier arguments arguing "that the discovery of a new property or use of a previously known composition ... cannot impart patentability to the claims to the known composition". While this may be useful statement of the law with respect to "known compositions" it is not relevant to claims directed to a method of producing a cadmium negative electrode for alkaline batteries. Again, applicants' claims 11-14 are directed to methods, not products.

In item 4 of the Official Action all claims are rejected as being "obvious" and therefore unpatentable over Stiker as the primary reference taken in combination with three secondary references. In item 5 of the Official Action the same claims are rejected as being "obvious" over Kobayashi as the primary reference in combination with the three secondary references mentioned above. Applicants submit that their claims define patentable subject matter and that both of these rejections should be withdrawn.

The present invention solves the problems as discussed in the specification [0003] to [0005]. Namely, particles of hexagonal β -cadmium hydroxide (β -Cd(OH)₂) may cause clogging of the pores of the cadmium negative electrode, or cover the surface of the active metallic cadmium. These problems especially occur in the sintered nickel coated electrode substance, which has fine pores.

Stiker and Kobayashi, both primary references, merely show a cadmium negative electrode made by filling cadmium active substances into a sintered nickel electrode substrate. These references fail to show an addition of polyethylene glycol as the Official Action acknowledges. Additionally, because neither reference addresses the problems to be solved by the present invention, there is no motivation to add the polyethylene glycol to the sintered nickel electrode substrate.

The cited primary references of Stiker and Kobayashi disclose merely "a sintered-type cadmium negative electrode", but does not show or suggest that "a sintered-type cadmium negative electrode" as applicants claim can cause the problem of "clogging of the pore".

The technique disclosed by Hirakawa relates to a non-sintered-type cadmium negative electrode produced by blending an active material with a binder to give rise to a paste or a slurry, depositing it on a planar conductive core body such as punching metal, etc. This process has nothing to do with a sintered-type cadmium negative electrode as set forth in the invention of the present application. Accordingly, in Hirakawa, which does not use "a sintered-type cadmium negative electrode", the problem of "clogging of the pore" never takes place. Further, applicants advise it is usually difficult to apply the technique Hirakawa uses on a non-sintered-type electrode to "the sintered-type cadmium negative electrode" of Stiker.

Oshitani is cited for its disclosure of polyethylene glycol, but this must be carefully read. The Oshitani reference requires an iron fiber sintered body on which a nickel plate is applied. The claim of Oshitani references says:

"A manufacturing method of a cadmium electrode plate for alkaline battery characterized in that an iron fiber sintered body having a porosity of 84-95% is plated with Ni, the sintered body is impregnated with an aqueous solution containing cadmium nitrate and a small amount of an organic corrosion inhibitor such as methyl alcohol, polyethylene glycol or carboxymethyl-cellulose, the impregnated sintered body is dipped in an alkaline solution to convert cadmium nitrate into cadmium hydroxide by chemical neutralization so that the cadmium hydroxide is filled in the electrode."

Oshitani also states that the iron fiber sintered body has large porosity in comparison with the nickel-sintered body. Oshitani reference says:

"The porosity of the iron fiber sintered body is very large in comparison with that of the nickel sintered body, which is restricted (to) about 80%.

Pores spaces exist in the sintered body is several times of the conventional nickel sintered body."

In case of an iron fiber sintered body having a larger porosity, the β -cadmium hydroxide (β -Cd(OH)₂) will not cause clogging of the pores of the cadmium negative electrode, thus the problems to which the present invention is directed do not exist.

Further, according to Oshitani, "a small amount" of polyethylene glycol is filled in the sintered body together with the cadmium nitrate, then the polyethylene glycol is removed by heating **before** the cadmium nitrate is converted in cadmium hydroxide. Oshitani references says:

"The sintered body is impregnated with an aqueous solution (cadmium nitrate solution having gravity 1.76 added with 5% methyl alcohol) at room temperature (15-20°C) under vacuum condition. An impregnated time period is about 10 minutes. After impregnation, it is dried at 90°C during 10 minutes to remove water and methyl alcohol. Then, the cadmium nitrate is converted into cadmium hydroxide in caustic soda having gravity 1.28 with 30 minutes. Thus obtained electrode plate is subjected ordinal chemical treatment in the caustic soda having gravity 1.28 to remove impurities. Finally, thus obtained electrode plate is cut into a suitable size to use as a negative electrode for an alkaline battery such as nickel-cadmium or silver-cadmium."

Thus as clearly stated in Oshitani, at the time cadmium hydroxide is generated, polyethylene glycol has been removed. Therefore, there cannot be a coating film formed on the surface of Oshitani's cadmium negative electrode or a surface of the cadmium active substances.

Additionally, as clearly stated in Oshitani, polyethylene glycol is used for a totally different purpose – as a corrosion inhibitor to prevent the iron fiber sintered body from corroding when the iron fiber sintered body is immersed in an acidic solution containing the cadmium nitrate. The purpose of the polyethylene glycol is completely different from the present invention.

In cited reference Oshitani, a solution resulting from mixing an active material with "a small amount of" poly(ethylene glycol) is filled in "a porous nickel-coated sintered core body". And, in Oshitani, after filling with the active material and "small amount of" poly(ethylene glycol), etc., "a preliminary charge is applied". However, since a preliminary charge is applied

under conditions such that the poly(ethylene glycol) is present in "the porous nickel-coated sintered core body", the effect of "preliminary charge application" can be hindered.

On the other hand, in contrast to Oshitani, in the present invention, poly(ethylene glycol) is applied after "application of a preliminary charge". Thus, the effect of preliminary charge application is not hindered, and applicants are able to solve the problem of "clogging of the pore". Moreover, even if the Oshitani procedure could be applied to "the sintered-type cadmium negative electrode" of Stiker, the method of the present invention would never be practical, since it is only possible to apply a preliminary charge after applying the poly(ethylene glycol), etc.

Treger merely shows molecular weight of polyethylene glycol which is not in dispute. It is not applied to a cadmium negative electrode.

Another objective of the process of the present invention, in addition to those discussed above, is to obtain a cadmium negative electrode for an alkali secondary cell that maintains metallic cadmium particles as the charge product to have a small diameter (i.e. a large specific surface area), by which the charge and discharge characteristics are improved (see paragraphs [0034] to [0037]).

In particular, the process of the invention, as reflected in claim 11, includes a step of applying a preliminary charge to the active substance packed electrode before incorporating it in the cell. This step is not taught by any of the cited references. Excellent characteristics can be obtained by the process as compared to the conventional technique because of at least the following factors:

In a sealed alkali secondary cell it is necessary, for preventing the inner pressure of the cell from being increased, that the capacity of the positive electrode active substance is restricted to a value smaller than the capacity of the negative electrode active substance to maintain the alkali secondary cell in a positive electrode restricted state. As one measure for satisfying the requirement, the active substance packed electrode is partially charged in an alkali aqueous solution to assure a prescribed extent of preliminary charge (reserved discharge) amount (see paragraph [0018]). By applying a preliminary charge amount to the active substance packed electrode by the aforementioned method (i.e. applying a small amount of charge to the active substance packed electrode), a small amount of metallic cadmium is formed in a finely dispersed state in the active substance packed electrode.

On charging the cell, on the other hand, cadmium hydroxide as the active substance is once dissolved in the alkali electrolytic solution and then deposited as metallic cadmium in the active substance packed electrode. An ordinary active substance packed electrode suffers no problem since formation of crystal nuclei of metallic cadmium is restricted. However, in the case where metallic cadmium is formed in advance in the active substance packed electrode by the partial charge as mentioned above, a previously unknown problem has been found – cadmium hydroxide dissolved in the alkali electrolytic solution is deposited with metallic cadmium as nuclei, by which crystals of metallic cadmium are grown to bring about significant deterioration in cycle characteristics. Accordingly, it will be understood that the present invention relates to a process for solving this problem peculiar to the case where an active substance packed electrode is partially charged to assure a prescribed amount of preliminary charge.

As a result of investigations on the problem by the inventors, it has been found that on charging the cell, cadmium hydroxide as the active substance is once dissolved in the alkali electrolytic solution and then deposited as metallic cadmium through cadmium complex ions.

As a result of further investigations, it has also been found that by chelating ether oxygen of polyethylene glycol to the cadmium complex ions, diffusion of cadmium complex ions is inhibited to maintain the particles of metallic cadmium deposited to have a small diameter.

The inventors have investigated a means for solving this problem, and have found that it is effective to charge the cell having incorporated in it an active substance packed electrode having a polyethylene glycol film formed thereon (see paragraph [0034], Table 1, and Figure 1).

Considering next the applied prior art documents, the cited references fail to show that a preliminary charge is applied to an active substance packed electrode before incorporation in a cell, and thus do not recognize the problem to be solved by the present invention.

As explained above, no reference shows a polyethylene glycol coating covering a surface of an electrode substrate or a surface of the cadmium active substance.

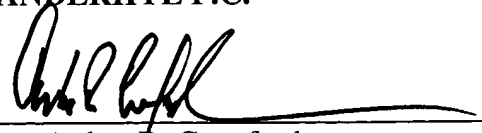
For the above reasons it is respectfully submitted that the claims of this application define inventive subject matter. Reconsideration and allowance are solicited.

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Respectfully submitted,

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